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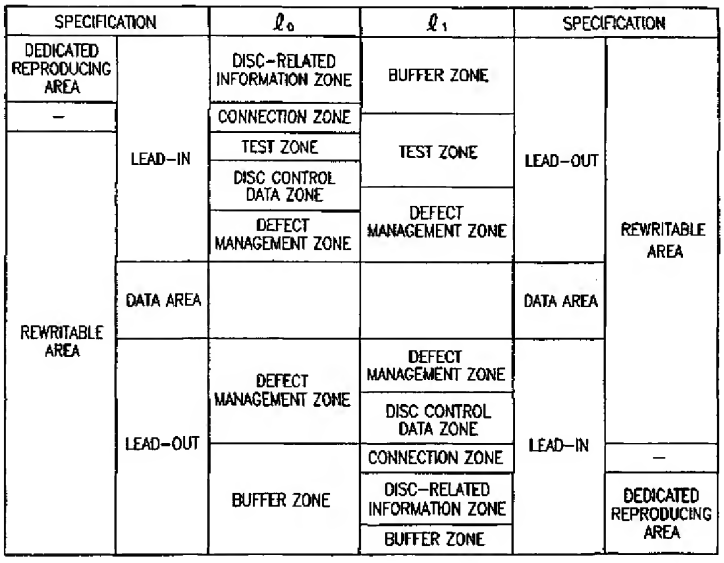
(54) Title: OPTICAL DISC HAVING A PLURALITY OF RECORDING LAYERS, AND RECORDING METHOD AND REPRODUCING METHOD THEREFOR



(57) Abstract: An optical disc having a plurality of recording layers, and a recording method and reproducing method therefor are provided. The optical disc has at least two recording layers, each layer having a lead-in area, a data area, and a lead-out area. In at least one of the lead-in and lead-out areas of the optical disc, there are a dedicated-reproducing area having a disc-related information zone and a rewritable area for reproducing user data recorded on the data area. With the optical disc, data recording/reproducing can be performed more reliably.

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OPTICAL DISC HAVING A PLURALITY OF RECORDING LAYERS, AND RECORDING METHOD AND REPRODUCING METHOD THEREFOR

Technical Field

The present invention relates to the field of optical discs, and more particularly, to an optical disc having at least two recording layers and a recording method and reproducing method therefor.

Background Art

Compact disc (CDs) and digital versatile disc (DVDs) are representative optical discs, which are information storage media widely used at present. However, as production and distribution of digital contents requiring a relatively large amount of data, such as audio/video (AV) data, rapidly increase, an optical disc having a higher recording capacity is needed for recording the digital content.

Among methods for increasing the recording capacity of an optical disc, there is a method in which 2 or more layers for recording user data are formed in the optical disc. However, reliable recording and reproducing is more difficult when there are 2 recording layers than when there is only 1 recording layer, because, for example, in order to separately read information recorded on each recording layer, a laser beam should be controlled more precisely, and reading error may occur more frequently due to stains on the disc surface.

Disclosure of the Invention

To solve the above problems, it is an objective of the present invention to provide an optical disc having a data structure such that when the optical disc has at least 2 recording layers, data can be recorded on and reproduced from the optical disc more reliably, and a recording method and reproducing method therefor.

In accordance with one aspect of the present invention, there is provided an optical disc having at least 2 recording layers, each of which has a lead-in area, a data area, and a lead-out area, wherein at least one of the lead-in area and lead-out area of the recording layer has a dedicated-reproducing area having a disc-related information zone, and a rewritable area for reproducing user data recorded in the data area.

According to more specific embodiments of the above optical disc according to the present invention, a connection zone is formed between the dedicated-reproducing area and the rewritable area. A test zone, a disc control data zone, and a defect management zone are formed in the rewritable area. Spiral tracks formed in the data areas of the recording layers have an identical winding direction. A spiral track formed in the data area of each recording layer has a winding direction opposite to the winding direction of a previous recording layer.

In accordance with another aspect of the present invention, there is provided an optical disc comprising: a first recording layer on which a first lead-in area, a first data area, and a first lead-out area are formed; and a second recording layer on which a second lead-in area, a second data area, and a second lead-out area are formed, wherein at least one of the first lead-in area and the second lead-in area has a dedicated-reproducing area having a disc-related information zone in which disc-related information is recorded, and a rewritable area for reproducing user data recorded in the data area corresponding to the lead-in area.

According to more specific embodiments of the above optical disc according to the present invention, the disc-related information is for both the first recording layer and the second recording layer. Disc-related information recorded in the first lead-in area is for the first recording layer, and disc-related information recorded in the second lead-in area is for the second recording layer.

In accordance with still another aspect of the present invention,

there is provided a method for recording user data on or reproducing user data from an optical disc having at least 2 recording layers, the method comprising: reading disc-related information from a disc-related information zone formed on one of an inner circumference and an outer circumference of a predetermined recording layer of the disc; if the disc-related information is not correctly read, reading the disc-related information from a disc-related information zone formed on the other of an inner circumference and an outer circumference of the other recording layer; and based on the read disc-related information, recording user data on or reproducing user data from the optical disc.

Brief Description of the Drawings

FIG. 1 is a schematic diagram of an optical disc according to a preferred embodiment of the present invention;

FIG. 2 is a reference diagram showing the recording/reproducing direction of the optical disc of FIG. 1;

FIG. 3 is a diagram of the structure of data in a lead-in/out area of FIG. 2;

FIG. 4 shows a first embodiment of the data structure recorded on the optical disc of FIG. 1;

FIG. 5 shows a second embodiment of the data structure recorded on the optical disc of FIG. 1;

FIGS. 6A and 6B show third embodiments of the data structure recorded on the optical disc of FIG. 1;

FIGS. 7A and 7B show fourth embodiments of the data structure recorded on the optical disc of FIG. 1;

FIG. 8 is a schematic diagram of an optical disc according to another preferred embodiment of the present invention;

FIG. 9 is a reference diagram showing the recording/reproducing direction of the optical disc of FIG. 8;

FIG. 10 shows a first embodiment of the data structure recorded

on the optical disc of FIG. 8;

FIG. 11 shows a second embodiment of the data structure recorded on the optical disc of FIG. 8;

FIG. 12 shows a first embodiment of a dedicated-reproducing area and rewritable area;

FIG. 13 shows a second embodiment of a dedicated-reproducing area and rewritable area;

FIG. 14 shows a third embodiment of a dedicated-reproducing area and rewritable area;

FIG. 15 shows a fourth embodiment of a dedicated-reproducing area and rewritable area;

FIGS. 16 through 20 are reference diagrams explaining a wobble signal modulation method; and

FIG. 21 is a flowchart explaining a recording/reproducing method according to a preferred embodiment of the present invention.

Best mode for carrying out the Invention

Referring to FIG. 1, an optical disc according to a preferred embodiment of the present invention has a first recording layer $\ell 0$ and a second recording layer $\ell 1$. On the first recording layer $\ell 0$ and the second recording layer $\ell 1$, respective spiral tracks having opposite directions are formed.

FIG. 2 shows the recording/reproducing direction of the optical disc of FIG. 1. Referring to FIG. 2, on each of the first recording layer $\ell 0$ and the second recording layer $\ell 1$, there are a lead-in area LI, a data area, and a lead-out area LO. Shaded areas are lead-in areas LI and lead-out areas LO, and the remaining areas are data areas on which user data are recorded. Data recorded in the lead-in areas and lead-out areas will be explained later in detail.

Recording and/or reproducing data is performed from an inner

circumference to an outer circumference of the disc by rotating the disc counterclockwise when the disc is seen from the source of a laser beam.

Accordingly, the recording/reproducing path of the optical disc of FIG. 1 follows an opposite track path (OTP) method in which the path begins in the lead-in area of the first recording layer $\ell 0$, extends through the lead-out area of the first recording layer $\ell 0$, and the lead-in area of the second recording layer $\ell 1$, and ends in the lead-out area of the second recording layer $\ell 1$. In the present invention, the lead-in area means an area of a recording layer where recording/reproducing in that recording layer begins, and the lead-out area means an area of a recording layer where recording/reproducing in that recording layer ends. Accordingly, the lead-in area and lead-out area are formed at the outer or inner circumference of the disc. In the present embodiment, the lead-in area of the first recording layer $\ell 0$ is formed at the inner circumference of the disc, and the lead-out area is formed at the outer circumference of the disc, while the lead-in area of the second recording layer $\ell 1$ is formed at the outer circumference of the disc, and the lead-out area is formed at the inner circumference.

FIG. 3 is a diagram of the structure of data in a lead-in/out area of FIG. 2. Referring to FIG. 3, the lead-in/out area comprises a dedicated-reproducing area and a rewritable area. A connection zone is formed between the dedicated-reproducing area and the rewritable area. The dedicated-reproducing area is an area on which dedicated-reproducing data which, once recorded, are not deleted are recorded in advance. The rewritable area is an area on which rewritable user data are recorded.

The dedicated-reproducing area has a disc-related information zone. In the disc-related information zone, basic information on the disc is recorded. For example, in the disc-related information zone, a reference code for easier adjustment of an optical pickup, such as the

location of a focus, and control data, such as the type of the disc, the size of the disc, the version number, the recording density, the number of recording layers, and sector numbers indicating data areas, may be recorded. The disc-related information may be recorded in only one of the first recording layer $\ell 0$ and the second recording layer $\ell 1$.

The connection zone plays the role of a transition area located between the dedicated-reproducing area and the rewritable area.

The rewritable area comprises a test zone, a disc control data zone, and a defect management zone. The test zone includes a disc test zone and/or a drive test zone. The disc test zone and drive test zone are for testing a recording pulse, etc. In the disc control data zone, control data for user data that are newly recorded in a data area are recorded. In the defect management zone, information for processing or managing defects in the disc is recorded.

In the disc control data zone, a variety of control data may be recorded. In the present embodiment, the disc control data zone comprises a plurality of areas in which predetermined control data are recorded, and reserved areas for future use. An example of control data is drive information. Drive information is information on a drive which was used in recording data, and includes manufacturer information, an identifier, etc.

However, when the lead-in/out area of a predetermined recording layer has the above-described structure, the lead-out/in area of the same recording layer has only a defect management zone and a buffer zone. The purpose of the defect management zone is the same as described above, and the buffer zone indicates a kind of a transition area, that is, a predetermined area or a boundary between areas.

FIG. 4 shows a first embodiment of the structure of data recorded on the optical disc of FIG. 1. Referring to FIG. 4, both the first recording layer $\ell 0$ and the second recording layer $\ell 1$ have respective

disc-related information zones. That is, a disc-related information zone is in each of the lead-in area of the first recording layer $\ell 0$ and the lead-out area of the second recording layer $\ell 1$. In the disc-related information zones, information on respective recording layers may be recorded separately, or together.

The remaining areas, that is, the connection zones, the test zones, the disc control data zones, and defect management zones, of the two layers are arranged in an identical order in the radial direction of the disc. In addition, there is a buffer zone in each of the lead-out area of the first recording layer $\ell 0$ and the lead-in area of the second recording layer $\ell 1$, so that the buffer zones meet the first recording layer $\ell 0$ on the recording/reproducing path.

FIG. 5 shows a second embodiment of the structure of data recorded on the optical disc of FIG. 1. Referring to FIG. 5, a disc-related information zone is only on the first recording layer $\ell 0$. In the disc-related information zone, information on both the first recording layer $\ell 0$ and the second recording layer $\ell 1$ is recorded.

The remaining areas, that is, the connection zones, the test zones, the disc control data zones, and the defect management zones, of the two layers are arranged in an identical order in the radial direction of the disc. Also, as in FIG. 4, there is a buffer zone in each of the lead-out area of the first recording layer $\ell 0$ and the lead-in area of the second recording layer $\ell 1$, so that the buffer zones meet each other on the recording/reproducing path.

FIGS. 6A and 6B show third embodiments of the structure of data recorded on the optical disc of FIG. 1. Referring to FIGS. 6A and 6B, both the first recording layer $\ell 0$ and the second recording layer $\ell 1$ have respective disc-related information zones. That is, a disc-related information zone is in each of the lead-in area of the first recording layer $\ell 0$ and the lead-out area of the second recording layer $\ell 1$. However,

the disc-related information zones, the connection zones, the disc control data zones, and the defect management zones of the two layers are arranged in the opposite order in the radial direction of the disc. As an exception, a test zone may be located only on the first recording layer $\ell 0$ as shown in FIG. 6a, or a test zone may be located on each of the two layers at a physically identical location (inner circumference or outer circumference) as shown in FIG. 6b. Meanwhile, there is a buffer zone in each of the lead-out area of the first recording layer $\ell 0$ and the lead-in area of the second recording layer $\ell 1$, so that the buffer zones meet each other on the recording/reproducing path.

The disc-related information zone of the first recording layer $\ell 0$ and the disc-related information zone of the second recording layer $\ell 1$ are recorded on the inner circumference and the outer circumference, respectively, of the optical disc. Accordingly, even when information cannot be correctly read from the inner/outer circumference of the disc because of dust or fingerprints on the disc surface, that information can be read from the disc-relation information zone on the outer/inner circumference. This structure improves the reliability of recording/reproducing. Moreover, when information on both recording layers is recorded in the disc-related information zone, the reliability of recording/reproducing is further improved.

FIGS. 7A and 7B show fourth embodiments of the structure of data recorded on the optical disc of FIG. 1.

Referring to FIGS. 7A and 7B, the first recording layer $\ell 0$ has both a dedicated-reproducing area and a rewritable area. In the disc-related information zone of the dedicated-reproducing area, information on both the first recording layer $\ell 0$ and the second recording layer $\ell 1$ is recorded. The first recording layer $\ell 0$ has the same data structure as explained referring to FIG. 3, while the second recording layer $\ell 1$ has a different data structure. That is, both the

lead-in area and lead-out area of the second recording layer $\ell 1$ are formed as rewritable areas. More specifically, the lead-in area of the second recording layer $\ell 1$ comprises a defect management zone, a disc control data zone, and a buffer zone, and the lead-out area of the second recording layer $\ell 1$ comprises a defect management zone, and a buffer zone. However, a test zone is located only on the first recording layer $\ell 0$ as shown in FIG. 7a, or a test zone may be located at a physically identical location (inner circumference or outer circumference) on each of the two layers as shown in FIG. 7b. Meanwhile, the buffer zone of the lead-out area of the first recording layer $\ell 0$ and the buffer zone of the lead-in area of the second recording layer $\ell 1$ are arranged in identical locations in the radial direction of the disc.

FIG. 8 is a schematic diagram of an optical disc according to another preferred embodiment of the present invention. Referring to FIG. 8, the optical disc has a first recording layer $\ell 0$ and a second recording layer $\ell 1$. On the first recording layer $\ell 0$ and the second recording layer $\ell 1$, respective spiral tracks having an identical winding direction are formed.

FIG. 9 shows the recording/reproducing direction of the optical disc of FIG. 8. Referring to FIG. 9, on each of the first recording layer $\ell 0$ and the second recording layer $\ell 1$, there are a lead-in area LI, a data area, and a lead-out area LO. Shaded areas are lead-in areas LI and lead-out areas LO, and the remaining areas are data areas on which user data are recorded. Data recorded in the lead-in areas and lead-out areas will be explained later in detail.

Recording and/or reproducing data is performed from an inner circumference to an outer circumference of the disc by rotating the disc counterclockwise when the disc is seen from the source of a laser beam. The recording/reproducing path of the optical disc of FIG. 9 follows a parallel track path (PTP) method in which the path begins in the lead-in

area of the first recording layer $\ell 0$ and ends in the lead-out area of the first recording layer $\ell 0$, and begins again in the lead-in area of the second recording layer $\ell 1$, and ends in the lead-out area of the second recording layer $\ell 1$. As described above referring to FIG. 2, the lead-in area in the present invention means an area of a recording layer where recording/reproducing in that recording layer begins, and the lead-out area means an area of a recording layer where recording/reproducing in that recording layer ends. Accordingly, in the present embodiment, the lead-in areas of the first recording layer $\ell 0$ and the second recording layer $\ell 1$ are formed at the inner circumferences of the disc, and the lead-out areas of the first recording layer $\ell 0$ and the second recording layer $\ell 1$ are formed at the outer circumferences of the disc.

FIG. 10 shows a first embodiment of the structure of data recorded on the optical disc of FIG. 8. Hereinafter, the meanings of a disc-related information zone, a connection zone, a disc control data zone, and a defect management zone are the same as explained above referring to FIG. 3.

Referring to FIG. 10, both the first recording layer $\ell 0$ and the second recording layer $\ell 1$ have respective disc-related information zones. That is, a disc-related information zone is in each of the lead-in areas of the first recording layer $\ell 0$ and the second recording layer $\ell 1$. In the disc-related information zones, information on respective recording layers may be recorded separately, or together. The remaining areas, that is, the connection zones, the test zones, the disc control data zones, and defect management zones, of the two layers are arranged in an identical order in the radial direction of the disc. In addition, in each of the lead-out area of the first recording layer $\ell 0$ and the lead-in area of the second recording layer $\ell 1$, there is a buffer zone.

However, the test zone may be formed on only one of the first recording layer $\ell 0$ and the second recording layer $\ell 1$.

FIG. 11 shows a second embodiment of the structure of data recorded on the optical disc of FIG. 8. Referring to FIG. 11, a disc-related information zone is only on the first recording layer $\ell 0$. In the disc-related information zone, information on both the first recording layer $\ell 0$ and the second recording layer $\ell 1$ is recorded.

The remaining areas, that is, the connection zones, the test zones, the disc control data zones, and the defect management zones, of the two layers are arranged in an identical order in the radial direction of the disc. Also, as in FIG. 10, there is a buffer zone in each of the lead-out area of the first recording layer $\ell 0$ and the lead-in area of the second recording layer $\ell 1$, so that the buffer zones meet each other on the recording/reproducing path.

Examples of a dedicated-reproducing area and a rewritable area formed in the lead-in/out area having the data structure described above will now be explained. However, a connection zone and a buffer zone are formed such that the zones have physical characteristics that can be distinguished from neighboring zones. For example, a connection zone and a buffer zone may be formed as mirror areas. If a neighboring zone is formed as a wobble track, the connection zone and buffer zone may be formed as wobble tracks with wobble signals different from the wobble signal recorded in the neighboring zone.

However, the test zone may be formed on only one of the first recording layer $\ell 0$ and the second recording layer $\ell 1$.

FIG. 12 shows a first embodiment of a dedicated-reproducing area and rewritable area. As shown in FIG. 12, the dedicated-reproducing area and rewritable area are formed as wobble tracks. Here, data on the dedicated-reproducing area are recorded as land pre-pits, and data on the rewritable area are loaded on a wobble signal and then recorded.

FIG. 13 shows a second embodiment of a dedicated-reproducing

area and rewritable area. As shown in FIG. 13, the dedicated-reproducing area is formed as a high-frequency wobble track on which a high-frequency wobble signal is recorded, and the rewritable area is formed as a low-frequency wobble track on which a low-frequency wobble signal is recorded.

In FIGS. 12 and 13, since both the dedicated-reproducing area and the rewritable area are formed as wobble tracks, the physical shapes are uniform on the entire disc. Accordingly, even when the disc has two or more recording layers, the reproduction characteristics are good.

FIG. 14 shows a third embodiment of a dedicated-reproducing area and rewritable area. As shown in FIG. 14, the dedicated-reproducing area is formed as a pre-pit area on which data are recorded as pre-pits, and the rewritable area is formed as a wobble track on which a wobble signal containing corresponding data is recorded. Since the rewritable area is also formed as a wobble track like a data area, the areas have a more uniform physical shape. Accordingly, even when the disc has two or more recording layers, the reproduction characteristics are good.

FIG. 15 shows a fourth embodiment of a dedicated-reproducing area and rewritable area. As shown in FIG. 15, the dedicated-reproducing area is formed as a wobble track on which a wobble signal containing corresponding data is recorded, and the data corresponding to the rewritable area is recorded as recording marks in the wobble track of the dedicated-reproducing area. Since in one area, the data of the dedicated-reproducing area is recorded as a wobble signal, and the data of the rewritable area is recorded as recording marks, the data area in which user data are recorded becomes relatively wider. Accordingly, this embodiment has a structure which is advantageous in increasing the recording capacity of the disc.

Meanwhile, the wobble track described above may have wobbles formed on both side walls of a groove and land as shown in FIG. 16(a), or may have wobbles formed on only one side wall of a land or groove as shown in FIG. 16(b).

In addition, in a wobble signal read from a wobble track, data is loaded by being modulated by any of the following methods. FIG. 17(a) shows a frequency modulation method in which the frequency of a wobble signal is modulated between two different values to represent data bits having a logic value "0" and data bits having a logic value "1". FIG. 17(b) shows a phase modulation method in which the phase of a wobble signal is modulated by reversal to represent data bits having a logic value "0" and data bits having a logic value "1". FIG. 17(c) shows an amplitude modulation method in which the amplitude of a wobble signal is modulated between two different values to represent data bits having a logic value "0" and data bits having a logic value "1". FIG. 18 shows a minimum shift keying (MSK) method in which only the frequency of a partial interval of a continuous wobble signal changes. FIG. 19 shows a saw tooth wobble (STW) method in which a wobble signal having a saw tooth shape is recorded. In the saw tooth wobble signal, a logic value is determined as "0" or "1" according to the direction of the slope of the saw tooth. In addition, as shown in FIG. 20, by forming different track pitches (TP1, TP2) of wobble tracks on which a wobble signal is recorded, crosstalk between tracks can be reduced.

Based on the structure described above, a recording/reproducing method according to the present invention will now be explained.

FIG. 21 is a flowchart explaining a recording/reproducing method according to a preferred embodiment of the present invention. Referring to FIG. 21, an optical disc is loaded into the recording/reproducing apparatus in step 2101. An optical pickup of the recording/reproducing apparatus reads disc-related information from a disc-related information zone located on one of the first recording layer

$\ell 0$ and the second recording layer $\ell 1$ in step 2102. It is then determined whether or not the disc-related information is read successfully in step 2103. If reading was unsuccessful, the optical pickup of the recording/reproducing apparatus reads disc-related information from a disc-related information zone in the other layer of the first recording layer $\ell 0$ and the second recording layer $\ell 1$ in step 2104. Based on the disc-relation information, the recording/reproducing apparatus records user data in a data area or reproduces user data recorded from the data area in step 2105. If the disc-related information is read successfully without error in step 2103, based on the information, user data is recorded on or reproduced from the optical disc in step 2105.

In an optical disc having 3 or more recording layers, in which information on all recording layers is recorded in each of disc-related information zones formed at different locations on respective recording layers, if reading information from a disc-related information zone of one recording layer fails, the information can be read from disc-related information zones of other recording layers, thereby improving the reliability of recording/reproducing.

As described above, according to the present invention, even in an optical disc having two or more recording layers, data can be recorded and reproduced more reliably.

Although the present invention has been described with reference to preferred embodiments thereof, it will be apparent to those skilled in the art that various modifications to the embodiments set forth herein may be made within the scope of the present invention as defined by the appended claims.

What is claimed is:

1. An optical disc having at least 2 recording layers, each of which has a lead-in area, a data area, and a lead-out area, wherein at least one of the lead-in area and lead-out area of the recording layer has a dedicated-reproducing area having a disc-related information zone, and a rewritable area for reproducing user data recorded in the data area.

2. The optical disc of claim 1, wherein a connection zone is formed between the dedicated-reproducing area and the rewritable area.

3. The optical disc of claim 1, wherein a test zone, a disc control data zone, and a defect management zone are formed in the rewritable area.

4. The optical disc of claim 3, wherein a defect management zone is formed in the lead-out area of the recording layer whose lead-in area has the disc-related information zone, or in the lead-in area of the recording layer whose lead-out area has the disc-related information zone.

5. The optical disc of claim 3, wherein spiral tracks formed in the data areas of the recording layers have an identical winding direction.

6. The optical disc of claim 3, wherein a spiral track formed in the data area of each recording layer has a winding direction opposite to the winding direction of a previous recording layer.

7. An optical disc comprising:

a first recording layer on which a first lead-in area, a first data area, and a first lead-out area are formed; and

a second recording layer on which a second lead-in area, a second data area, and a second lead-out area are formed,

wherein at least one of the first lead-in area and the second lead-in area has a dedicated-reproducing area having a disc-related information zone in which disc-related information is recorded, and a rewritable area for reproducing user data recorded in the data area corresponding to the lead-in area.

8. The optical disc of claim 7, wherein the disc-related information is for both the first recording layer and the second recording layer.

9. The optical disc of claim 7, wherein disc-related information recorded in the first lead-in area is for the first recording layer, and disc-related information recorded in the second lead-in area is for the second recording layer.

10. The optical disc of claim 9, wherein a test zone, a disc control data zone, and a defect management zone are formed in the rewritable area.

11. The optical disc of claim 10, wherein a defect management zone is formed in each of the first lead-out area and the second lead-out area.

12. The optical disc of claim 11, wherein the first lead-in area, the first data area, and the first lead-out area are arranged in the same order as the second lead-in area, the second data area, and the second lead-out area, in the radial direction of the disc.

13. The optical disc of claim 12, wherein a buffer zone is formed adjacent to the defect management zone in each of the first lead-out area and the second lead-out area.

14. The optical disc of claim 11, wherein the first lead-in area, the first data area, and the first lead-out area are arranged in the opposite order as the second lead-out area, the second data area, and the second lead-in area, in the radial direction of the disc.

15. The optical disc of claim 14, wherein a buffer zone is formed in each of the first lead-out area and the second lead-in area such that the buffer zone is adjacent to the first lead-out area and the second lead-in area on a reproducing path.

16. The optical disc of claim 7, wherein the dedicated-reproducing area is formed as wobble tracks in which data corresponding to the area are recorded as land pre-pits, and the rewritable area is formed as wobble tracks in which a wobble signal containing corresponding data is recorded.

17. The optical disc of claim 7, wherein the dedicated-reproducing area is formed as high-frequency wobble tracks in which a high-frequency wobble signal containing corresponding data is recorded, and the rewritable area is formed as low-frequency wobble tracks in which a low-frequency wobble signal containing corresponding data is recorded.

18. The optical disc of claim 7, wherein the dedicated-reproducing area is formed as a pre-pitted area in which data corresponding to the area are recorded as pre-pits, and the rewritable

area is formed with wobble tracks in which a wobble signal containing corresponding data is recorded.

19. The optical disc of claim 7, wherein the dedicated-reproducing area is formed as wobble tracks in which a wobble signal containing corresponding data is recorded, and the data corresponding to the rewritable area are recorded as recording marks in the wobble tracks of the dedicated-reproducing area.

20. The optical disc of claim 17, wherein the data contained in the wobble signal are contained after being modulated by at least one of frequency modulation, amplitude modulation, phase modulation, and saw tooth modulation.

21. A method for recording user data on or reproducing user data from an optical disc having at least 2 recording layers, the method comprising:

reading disc-related information from a disc-related information zone formed on one of an inner circumference and an outer circumference of a predetermined recording layer of the disc;

if the disc-related information is not correctly read, reading the disc-related information from a disc-related information zone formed on the other of an inner circumference and an outer circumference of the other recording layer; and

based on the read disc-related information, recording user data on or reproducing user data from the optical disc.

FIG. 1

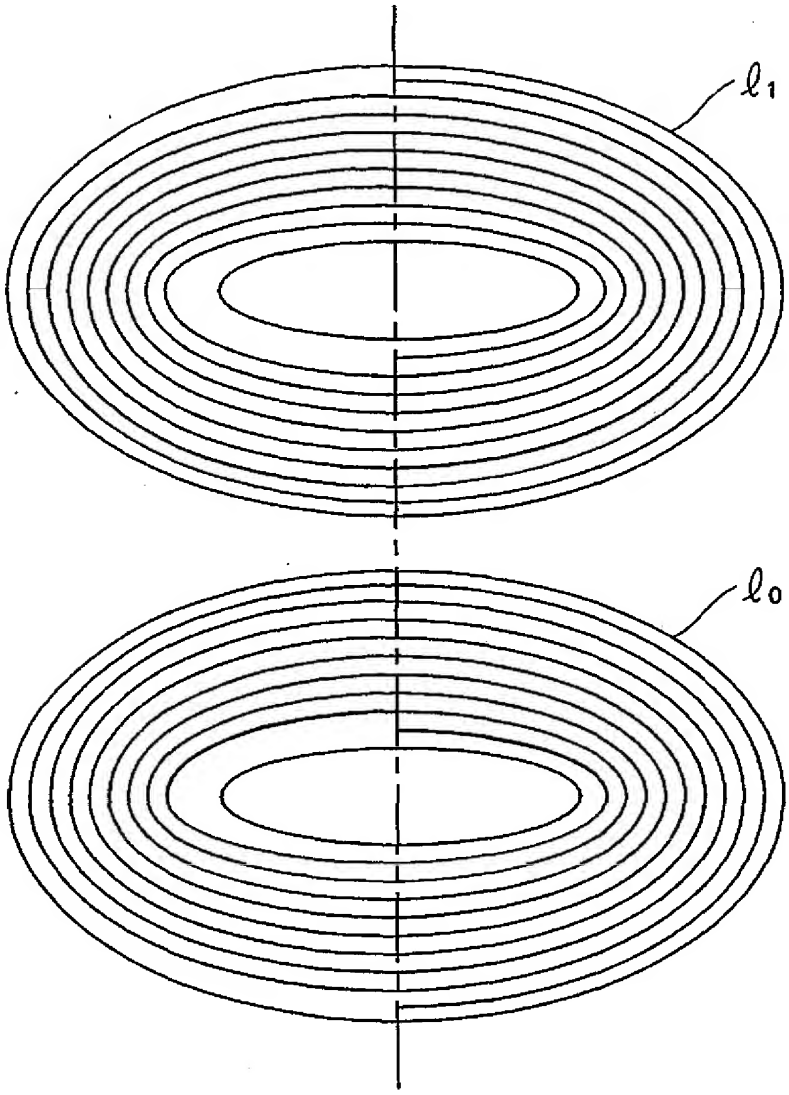


FIG. 2

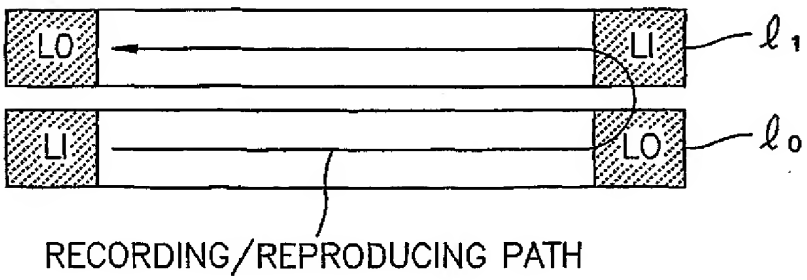


FIG. 3

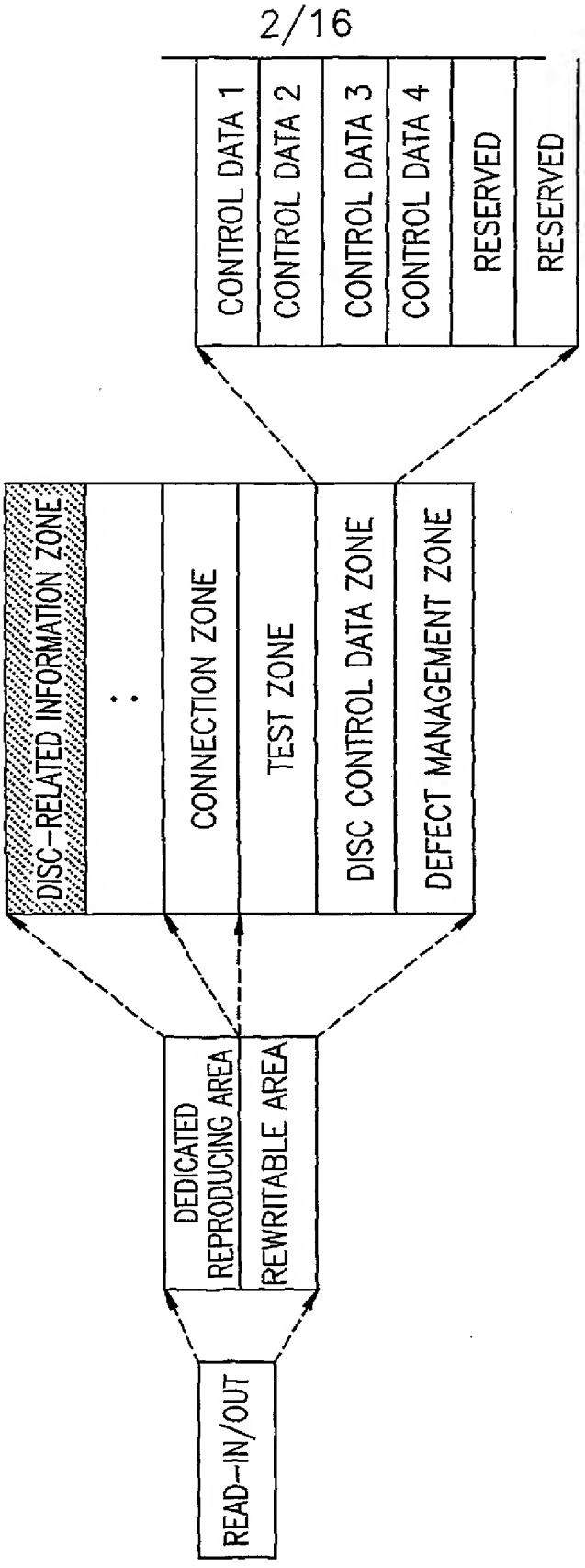

READ-IN/OUT
DEDICATED REPRODUCING AREA
REWRITABLE AREA
DISC-RELATED INFORMATION ZONE
:
CONNECTION ZONE
TEST ZONE
DISC CONTROL DATA ZONE
DEFECT MANAGEMENT ZONE
CONTROL DATA 1
CONTROL DATA 2
CONTROL DATA 3
CONTROL DATA 4
RESERVED
RESERVED

FIG. 4

SPECIFICATION		ℓ_0	ℓ_1	
DEDICATED REPRODUCING AREA	LEAD-IN	DISC-RELATED INFORMATION ZONE	DISC-RELATED INFORMATION ZONE	LEAD-OUT
—		CONNECTION ZONE	CONNECTION ZONE	
REWRITABLE AREA		TEST ZONE	TEST ZONE	
		DISC CONTROL DATA ZONE	DISC CONTROL DATA ZONE	
		DEFECT MANAGEMENT ZONE	DEFECT MANAGEMENT ZONE	
	DATA AREA			DATA AREA
	LEAD-OUT	DEFECT MANAGEMENT ZONE	DEFECT MANAGEMENT ZONE	LEAD-IN
		BUFFER ZONE	BUFFER ZONE	

FIG. 5

SPECIFICATION		ℓ_0	ℓ_1	
DEDICATED REPRODUCING AREA	LEAD-IN	DISC-RELATED INFORMATION ZONE	–	LEAD-OUT
–		CONNECTION ZONE	CONNECTION ZONE	
REWRITABLE AREA		TEST ZONE	TEST ZONE	
		DISC CONTROL DATA ZONE	DISC CONTROL DATA ZONE	
		DEFECT MANAGEMENT ZONE	DEFECT MANAGEMENT ZONE	
	DATA AREA			DATA AREA
	LEAD-OUT	DEFECT MANAGEMENT ZONE	DEFECT MANAGEMENT ZONE	LEAD-IN
		BUFFER ZONE	BUFFER ZONE	

FIG. 6A

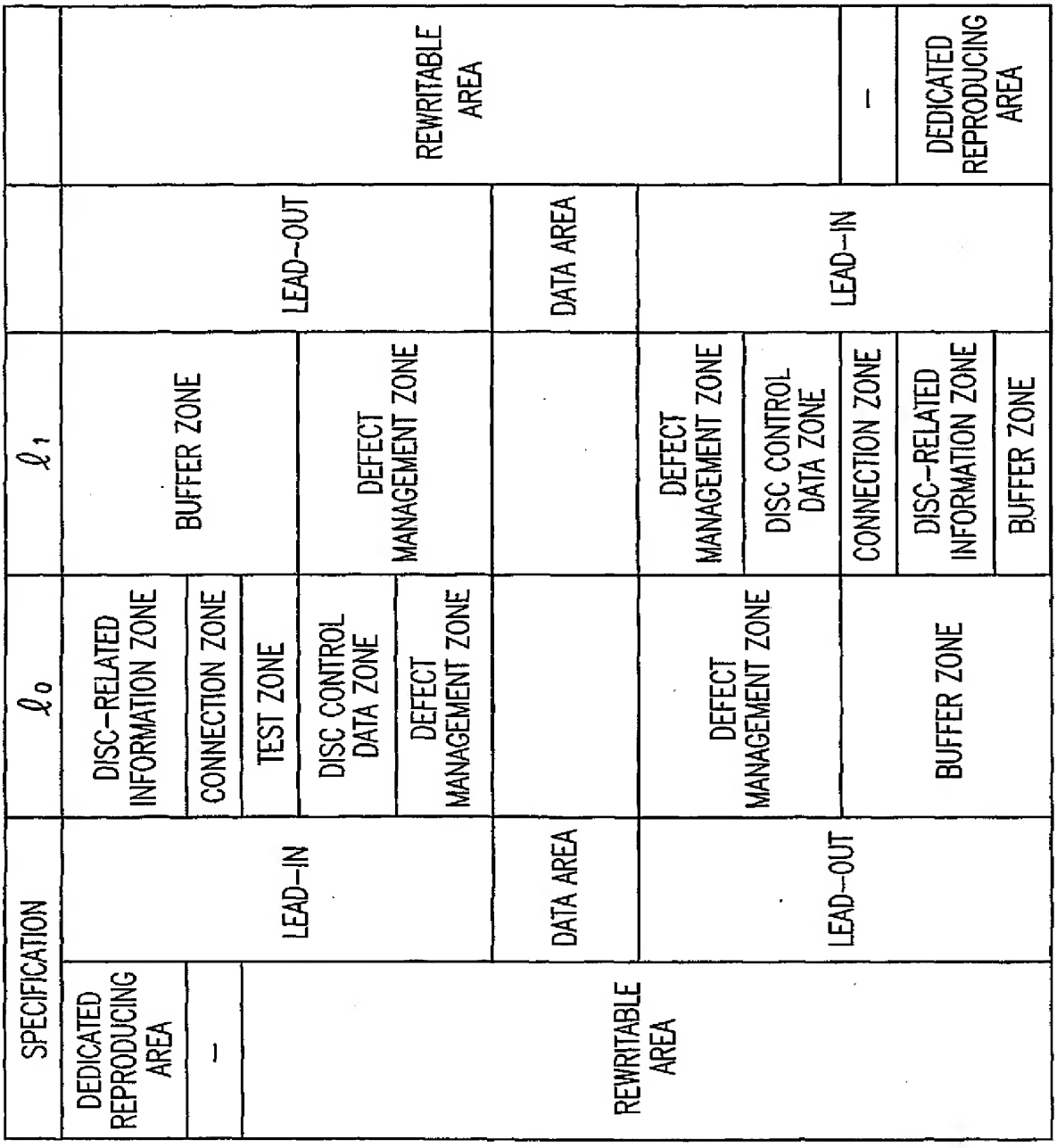


FIG. 6B

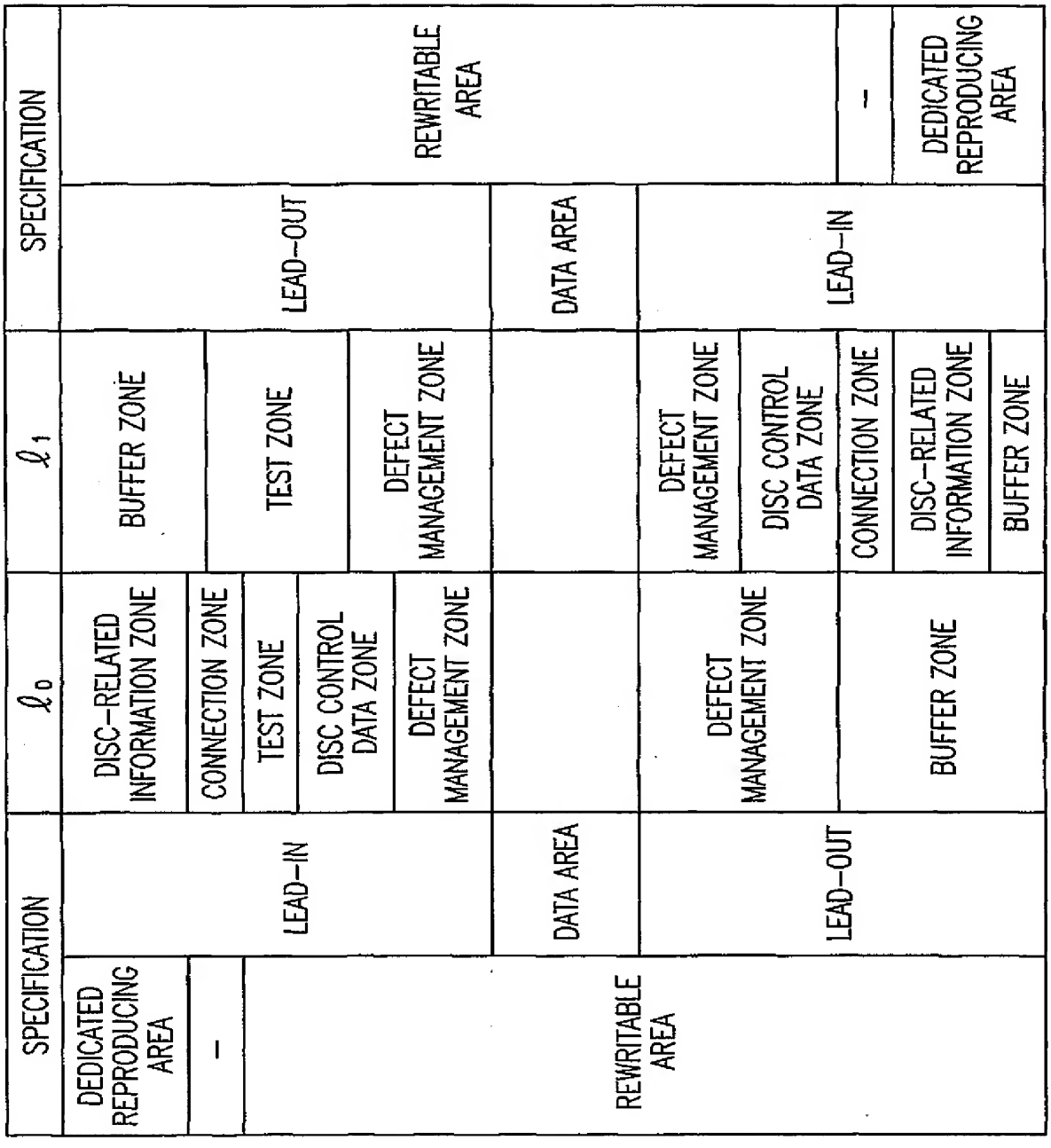

SPECIFICATION
ℓ_0
ℓ_1
SPECIFICATION
DEDICATED REPRODUCING AREA
–
LEAD-IN
DISC-RELATED INFORMATION ZONE
CONNECTION ZONE
TEST ZONE
DISC CONTROL DATA ZONE
DEFECT MANAGEMENT ZONE
BUFFER ZONE
TEST ZONE
DEFECT MANAGEMENT ZONE
LEAD-OUT
REWRITABLE AREA
DATA AREA
DATA AREA
REWRITABLE AREA
LEAD-OUT
DEFECT MANAGEMENT ZONE
BUFFER ZONE
LEAD-IN
DEFECT MANAGEMENT ZONE
DISC CONTROL DATA ZONE
CONNECTION ZONE
DISC-RELATED INFORMATION ZONE
BUFFER ZONE
–
DEDICATED REPRODUCING AREA

FIG. 7A

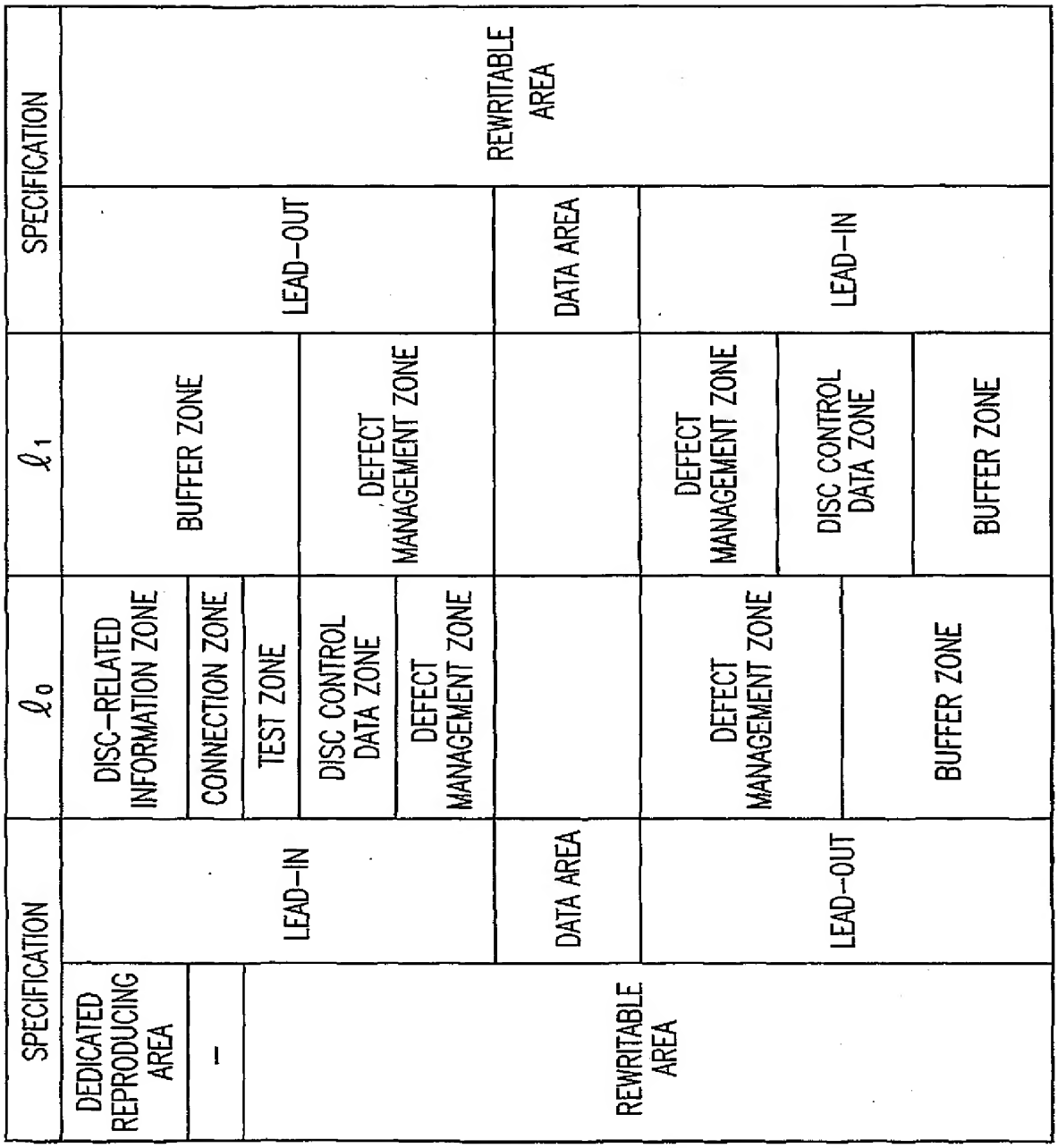

SPECIFICATION
ℓ_0
ℓ_1
SPECIFICATION
DEDICATED REPRODUCING AREA
DISC-RELATED INFORMATION ZONE
BUFFER ZONE
LEAD-OUT
REWRITABLE AREA
–
CONNECTION ZONE
LEAD-IN
TEST ZONE
DISC CONTROL DATA ZONE
DEFECT MANAGEMENT ZONE
DEFECT MANAGEMENT ZONE
DATA AREA
DATA AREA
REWRITABLE AREA
DEFECT MANAGEMENT ZONE
DISC CONTROL DATA ZONE
LEAD-IN
LEAD-OUT
BUFFER ZONE
BUFFER ZONE

FIG. 7B

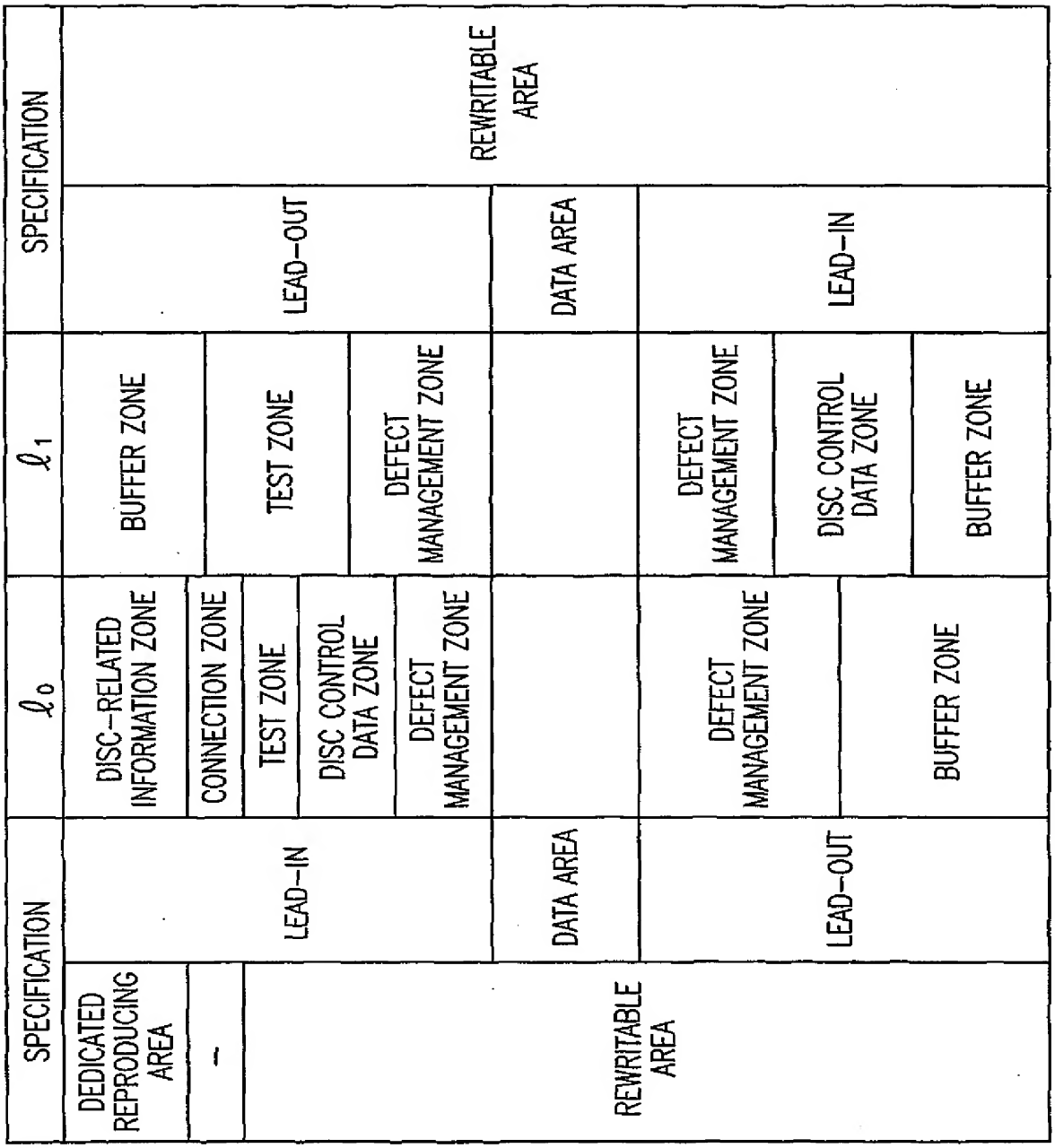

SPECIFICATION
l_0
l_1
SPECIFICATION
DEDICATED REPRODUCING AREA
–
REWRITABLE AREA
LEAD-IN
DISC-RELATED INFORMATION ZONE
CONNECTION ZONE
TEST ZONE
DISC CONTROL DATA ZONE
DEFECT MANAGEMENT ZONE
BUFFER ZONE
TEST ZONE
DEFECT MANAGEMENT ZONE
LEAD-OUT
REWRITABLE AREA
DATA AREA
DATA AREA
LEAD-OUT
DEFECT MANAGEMENT ZONE
BUFFER ZONE
DEFECT MANAGEMENT ZONE
DISC CONTROL DATA ZONE
BUFFER ZONE
LEAD-IN

FIG. 8

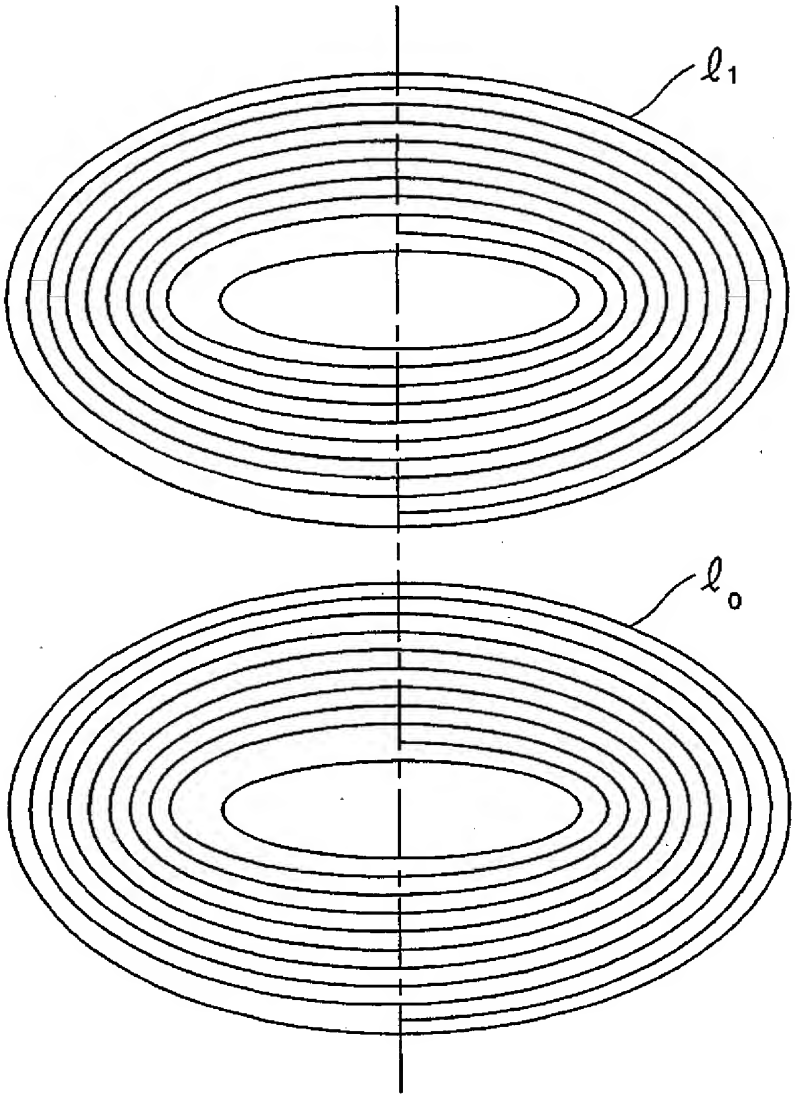


FIG. 9

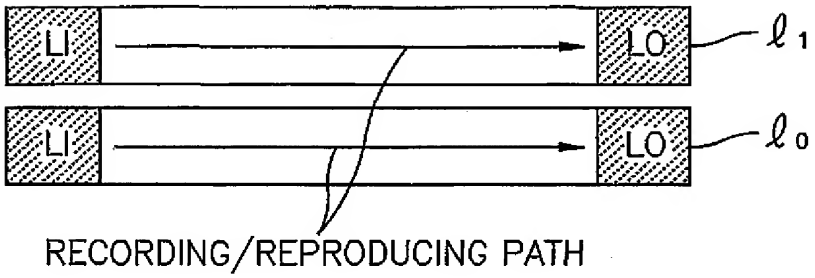


FIG. 10

SPECIFICATION		ℓ_0	ℓ_1
DEDICATED REPRODUCING AREA	LEAD-IN	DISC-RELATED INFORMATION ZONE	DISC-RELATED INFORMATION ZONE
—		CONNECTION ZONE	CONNECTION ZONE
REWRITABLE AREA		TEST ZONE	TEST ZONE
		DISC CONTROL DATA ZONE	DISC CONTROL DATA ZONE
		DEFECT MANAGEMENT ZONE	DEFECT MANAGEMENT ZONE
	DATA AREA		
	LEAD-OUT	DEFECT MANAGEMENT ZONE	DEFECT MANAGEMENT ZONE
		BUFFER ZONE	BUFFER ZONE

FIG. 11

SPECIFICATION		ℓ_0	ℓ_1
DEDICATED REPRODUCING AREA	LEAD-IN	DISC-RELATED INFORMATION ZONE	-
-		CONNECTION ZONE	CONNECTION ZONE
REWRITABLE AREA		TEST ZONE	TEST ZONE
		DISC CONTROL DATA ZONE	DISC CONTROL DATA ZONE
		DEFECT MANAGEMENT ZONE	DEFECT MANAGEMENT ZONE
	DATA AREA		
	LEAD-OUT	DEFECT MANAGEMENT ZONE	DEFECT MANAGEMENT ZONE
		BUFFER ZONE	BUFFER ZONE

FIG. 12

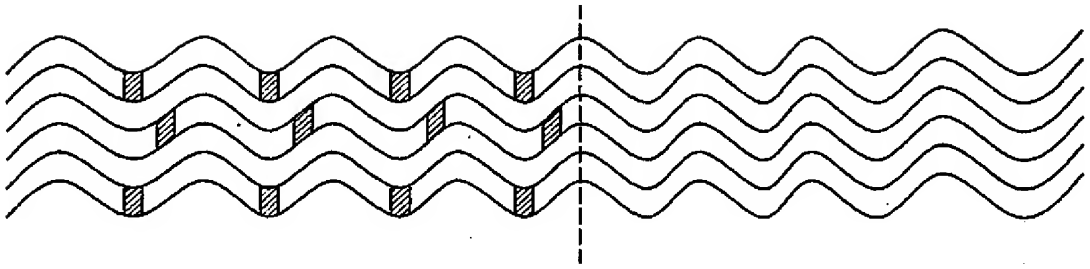


FIG. 13

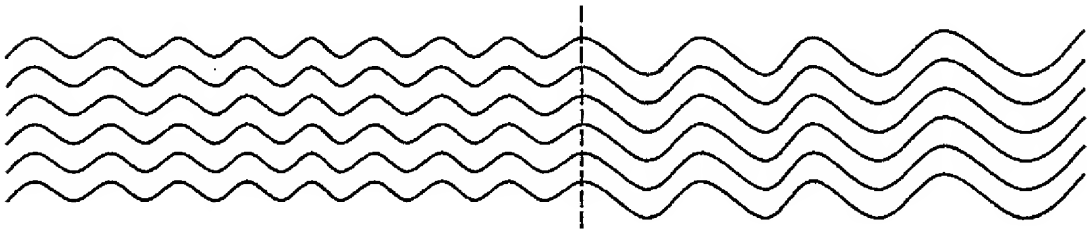


FIG. 14

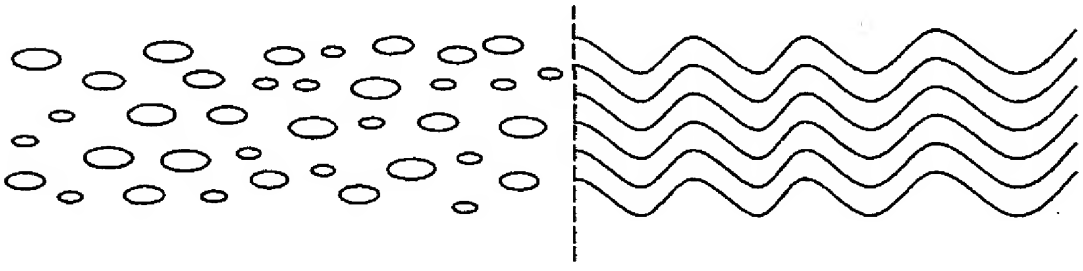


FIG. 15

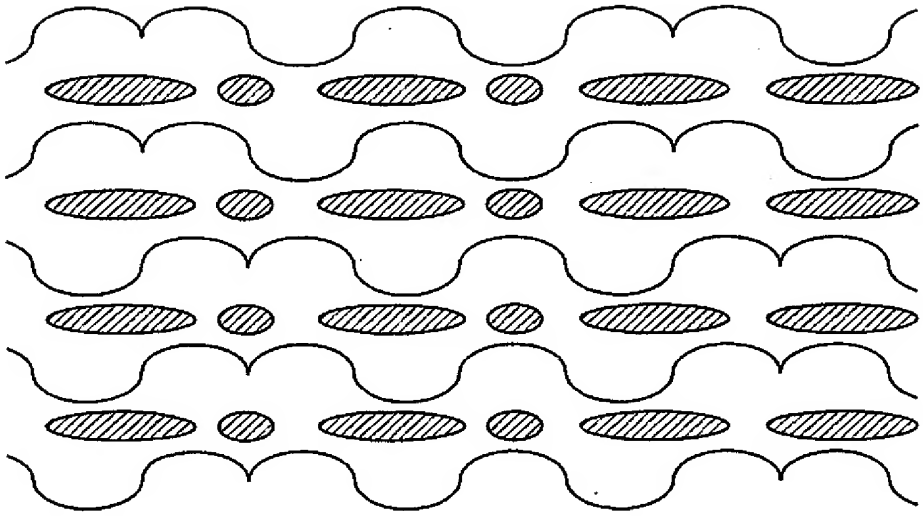


FIG. 16

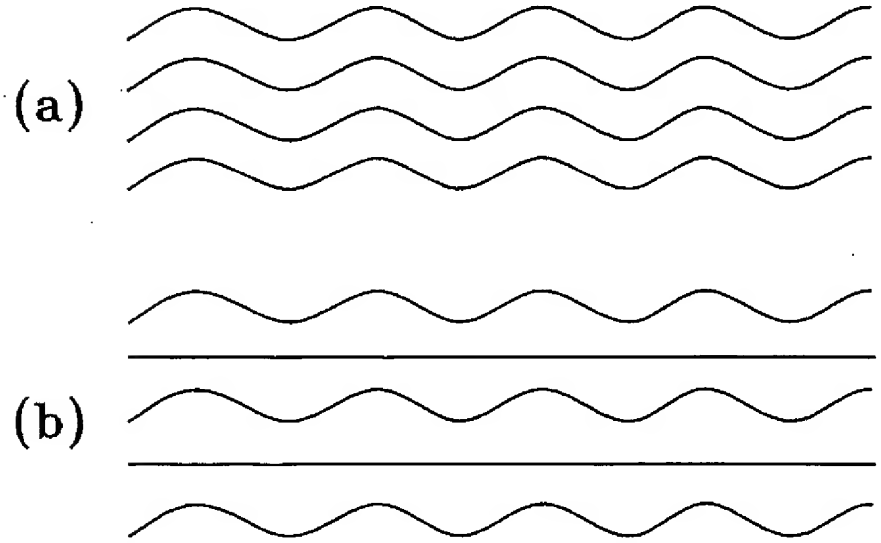
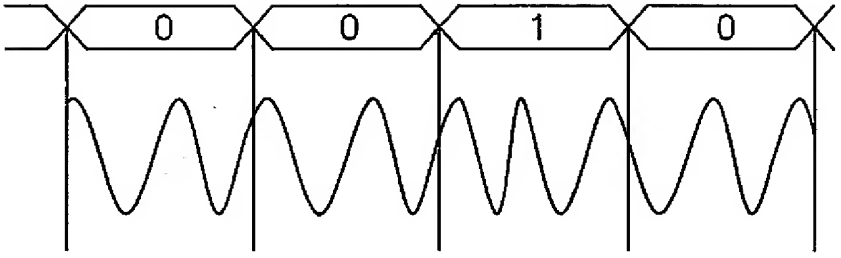
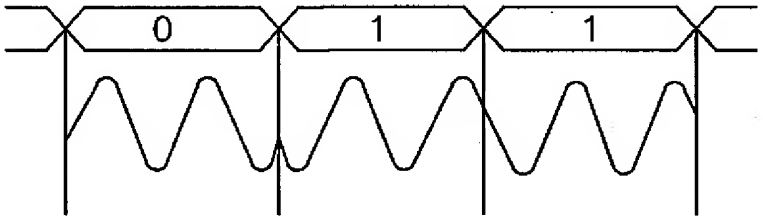


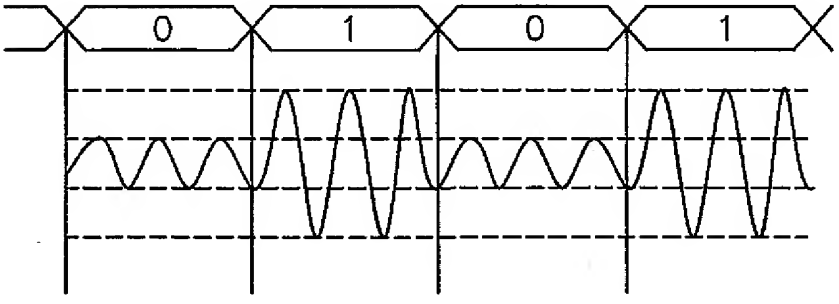
FIG. 17



(a)



(b)



(c)

FIG. 18

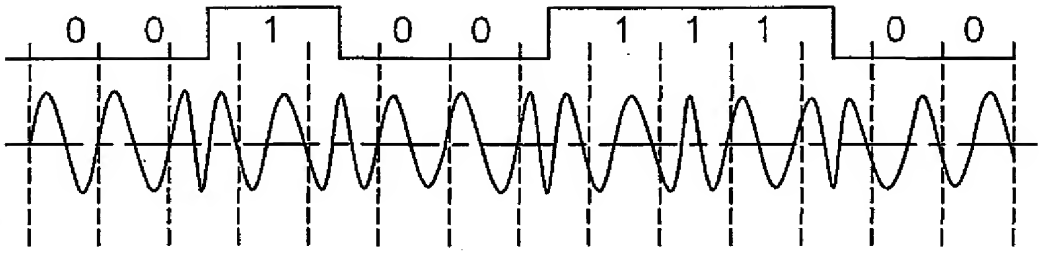


FIG. 19

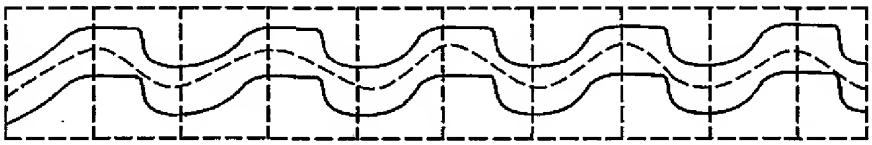


FIG. 20

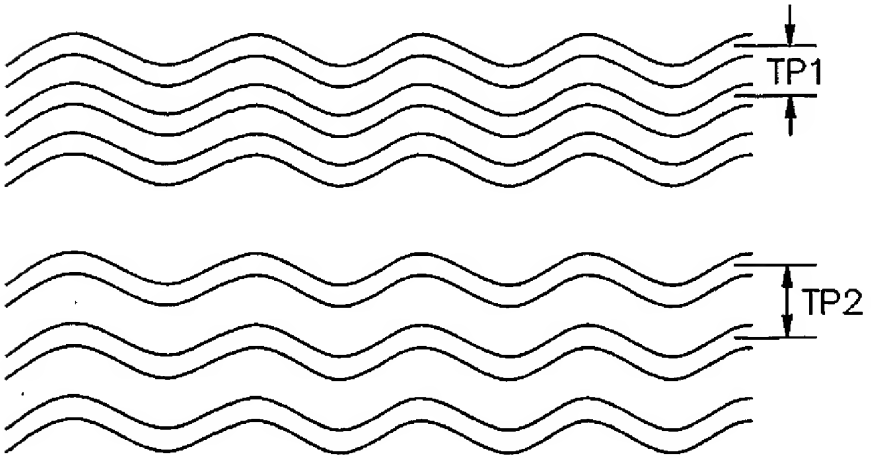
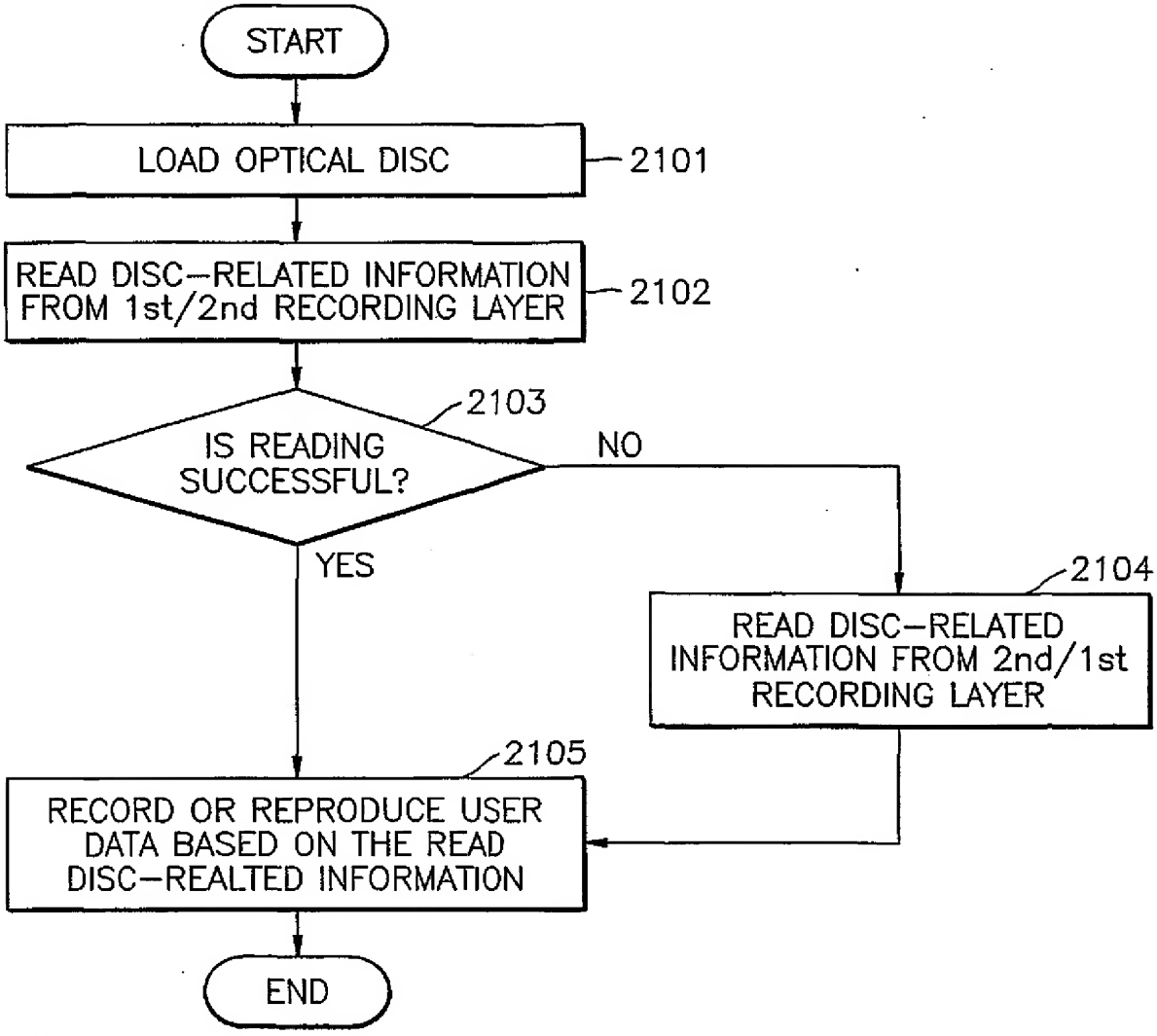


FIG. 21


START
LOAD OPTICAL DISC
2101
READ DISC-RELATED INFORMATION FROM 1st/2nd RECORDING LAYER
2102
IS READING SUCCESSFUL?
2103
NO
YES
READ DISC-RELATED INFORMATION FROM 2nd/1st RECORDING LAYER
2104
RECORD OR REPRODUCE USER DATA BASED ON THE READ DISC-REALTED INFORMATION
2105
END

International application No.
PCT/KR03/00755

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G11B 7/007

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 G11B 7/007

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KOREAN PATENTS AND APPLICATIONS FOR INVENTION SINCE 1975
KOREAN UTILITY MODELS AND APPLICATIONS FOR UTILITY MODEL SINCE 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,737,287 A (LG ELECTRONICS) 7 APRIL 1998 see the whole document	1, 7, 21
A	KR 2001 - 0011557 A (LG ELECTRONICS) 15 FEBRUARY 2001 see the whole document	1, 7, 21

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 JULY 2003 (15.07.2003)	15 JULY 2003 (15.07.2003)

Name and mailing address of the ISA/KR

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Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

SHIN, Sung Kil

Telephone No. 82-42-481-5688

Form PCT/ISA/210 (second sheet) (July 1998)